REMARKS

Applicants respectfully request consideration of this application. The following arguments are provided to impart precision to the claims, by more particularly pointing out the invention, rather than to avoid prior art.

Claims 1 – 5, 7 – 14, 16 and 17 have been rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 6,150,223 to Chern et al. (hereinafter "Chern") in view of U.S. Patent 5,976,991 to Laxman et al. (hereinafter "Laxman"). Claims 15, 18 and 19 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Chern and Laxman as applied to claims 11 and 17, and further in view of U.S. Patent ~~6,233,597~~ 6235597 to Miles (hereinafter "Miles").

A.M
4/21/04

The specification has been amended to reflect a title change made in the Response to Office Action dated March 21, 2003 (Paper No. 17). Claims 1 and 11 have been amended. The amendments are supported by the specification and no new matter has been added. No new claims have been added and no claims have been canceled. As such, claims 1 – 5 and 7 – 19 remain pending in this application.

35 U.S.C. § 103(a) Rejections

Amended independent claim 1 provides:

> A method of forming sidewall spacers adjacent opposing vertical sides of a gate electrode, comprising:
>
> forming at least one gate electrode over a substrate;
>
> forming, at a first temperature in a range of approximately 550°C to 580°C and a first pressure of about 10 mTorr, a first silicon oxide film conformally over the substrate and gate electrode

from a combination of gases including bis-(tertiarybutylamino)silane and oxygen;

forming, at a second temperature in a range of 580°C to approximately 600°C, a silicon nitride film conformally over the first silicon oxide film from a combination of gases including bis-(tertiarybutylamino)silane; and

forming a second silicon oxide film over the silicon nitride film from a combination of gases including bis-(tertiarybutylamino)silane and oxygen; ***wherein the first temperature is less than the second temperature***.
(emphasis added)

Chern discloses a method for forming a double-layer spacer. A first photoresist layer 26 is deposited on the interior circuit. Subsequently, a first spacer 22D of about 600-700 angstroms and second a spacer 24C of about 500-600 angstroms are formed on the sidewalls of the gate of the peripheral circuit by self-aligning RIE method, wherein the spacers consist of silicon nitride and silicon oxide, separately. (Chern, col. 2, lines 65 – 68, and col. 3, lines 1 – 4, and FIG. 5). Nothing in Chern teaches or suggests forming a first silicon oxide film at a first temperature and a silicon nitride film at a second temperature which is greater than the first temperature.

Laxman discloses a method for chemical vapor deposition in which bis(tertiarybutylamino)silane is reacted with N_2O and NH_3 at 600 ^{0}C and 500 mTorr reactor pressure. The precursor and reactants are introduced into the heated reactor. Using 60 sccm BTBAS with varying amounts of N_2O and NH_3, the film properties could be varied from a silicon nitride to various silicon oxynitrides. The average deposition rate varied from 20 to 29 Angstroms per minute, with higher

rates occuring with higher percentages of N_2 O. (Laxman, col. 8, lines 57 – 67). Laxman also discloses that the temperature and pressure were maintained at 600 ^{0}C and 500 mTorr for these depositions. The film refractive index then changed from near 2.0 (silicon nitride) to 1.46 (silicon oxide). A dielectric stack of oxides, nitrides, and oxynitrides ***may be deposited in a single reactor at a fixed temperature and pressure***. (emphasis added) (Laxman, col. 9, lines 1 – 7). Nothing in Laxman teaches or suggests forming a first silicon oxide film at a first temperature and a silicon nitride film at a second temperature which is greater than the first temperature. As such, Laxman fails to cure the deficiency of Chern.

It is respectfully submitted that Chern and Laxman do not teach or suggest a combination with each other. Applicants respectfully submit that it would be impermissible hindsight, based on Applicants' own disclosure to combine Chern and Laxman.

Applicants also respectfully submit that there is no motivation to combine Chern and Laxman. The Office Action states, "It would have been obvious for one of ordinary skill in the art, at the time of the invention to form the silicon oxide, silicon nitride and silicon oxide of Chern using a precursor silane including BTBAS at temperatures and pressures as taught by Laxman because BTBAS does not contain direct Si-C bonds thus, the deposited films have very low carbon content." (Office Action dated 05/19/2003, page 3). Here, the Office Action merely states an advantage of substituting the BTBAS from Laxman into the method of Chern without explaining what specific understanding or technological principle within the knowledge of one of ordinary skill in the art would have suggested the combination.

In fact, Laxman teaches away from using more than one temperature setting because the process is "directed to bis(tertiarybutylamino)silanes as a class of aminosilanes that deposit silicon dioxide and silicon oxynitride at the same unexpectedly low temperatures." (Laxman, col. 4, lines 60 – 64).

Even if Chern and Laxman were combined, the combination would still not result in the limitations of claim 1. In particular, Chern and Laxman do not include the limitation, "wherein the first temperature is less than the second temperature." As the Chern and Laxman references, alone or in combination do not teach all the limitations of claim 1, the combination cannot be interpreted do disclose the limitations of claim 1. Therefore, Applicants respectfully request the withdrawal of the rejection of the claims under 35 U.S.C. § 103(a) over the combination.

Claims 2 – 5 and 7 – 10 depend either directly or indirectly from independent claim 1, and thus include the limitation "wherein the first temperature is less than the second temperature." As such, Applicants respectfully submit that claims 2 – 5 and 7 – 10 are also not unpatentable by the combination of Chern and Laxman under 35 U.S.C. § 103(a) and request withdrawal of the rejection of the claims.

Amended independent claim 11 provides:

> A method of forming a transistor, comprising:
>
> forming at least one gate electrode over a gate dielectric layer, the gate dielectric layer disposed on a substrate;
>
> depositing a first silicon oxide film conformally over the substrate and gate electrode from a combination of gases comprising bis-(tertiarybutylamino)silane and oxygen at a first temperature of between approximately 550°C and 580°C and a pressure of about 10 mTorr;

depositing a silicon nitride film conformally over the first silicon oxide film from a combination of gases comprising bis-(tertiarybutylamino)silane and ammonia at a second temperature of between 580°C and approximately 600°C;

depositing a second silicon oxide film over the silicon nitride film from a combination of gases comprising bis-(tertiarybutylamino)silane and oxygen; and

forming a first sidewall spacer; ***wherein the first temperature is less than the second temperature***.
(emphasis added)

Chern discloses a method for forming a double-layer spacer. A first photoresist layer 26 is deposited on the interior circuit. Subsequently, a first spacer 22D of about 600-700 angstroms and second a spacer 24C of about 500 – 600 angstroms are formed on the sidewalls of the gate of the peripheral circuit by self-aligning RIE method, wherein the spacers consist of silicon nitride and silicon oxide, separately. (Chern, col. 2, lines 65 – 68, and col. 3, lines 1 – 4, and FIG. 5). Nothing in Chern teaches or suggests depositing a first silicon oxide film at a first temperature and a silicon nitride film at a second temperature which is greater than the first temperature.

Laxman discloses a method for chemical vapor deposition in which bis(tertiarybutylamino)silane is reacted with N_2O and NH_3 at 600 ^{0}C and 500 mTorr reactor pressure. The precursor and reactants are introduced into the heated reactor. Using 60 sccm BTBAS with varying amounts of N_2O and NH_3, the film properties could be varied from a silicon nitride to various silicon oxynitrides. The average deposition rate varied from 20 to 29 Angstroms per minute, with higher

rates occuring with higher percentages of N_2O. (Laxman, col. 8, lines 57 – 67). Laxman also discloses that the temperature and pressure were maintained at 600 ^{0}C and 500 mTorr for these depositions. The film refractive index then changed from near 2.0 (silicon nitride) to 1.46 (silicon oxide). A dielectric stack of oxides, nitrides, and oxynitrides ***may be deposited in a single reactor at a fixed temperature and pressure.*** (emphasis added) (Laxman, col. 9, lines 1 – 7). Nothing in Laxman teaches or suggests depositing a first silicon oxide film at a first temperature and a silicon nitride film at a second temperature which is greater than the first temperature. As such, Laxman fails to cure the deficiency of Chern.

It is respectfully submitted that Chern and Laxman do not teach or suggest a combination with each other. Applicants respectfully submit that it would be impermissible hindsight, based on Applicants' own disclosure to combine Chern and Laxman.

Applicants also respectfully submit that there is no motivation to combine Chern and Laxman. The Office Action states, "It would have been obvious for one of ordinary skill in the art, at the time of the invention to form the silicon oxide, silicon nitride and silicon oxide of Chern using a precursor silane including BTBAS at temperatures and pressures as taught by Laxman because BTBAS does not contain direct Si-C bonds thus, the deposited films have very low carbon content." (Office Action dated 05/19/2003, page 3). Here, the Office Action merely states an advantage of substituting the BTBAS from Laxman into the method of Chern without explaining what specific understanding or technological principle within the knowledge of one of ordinary skill in the art would have suggested the combination.

In fact, Laxman teaches away from using more than one temperature setting because the process is "directed to bis(tertiarybutylamino)silanes as a class of aminosilanes that deposit silicon dioxide and silicon oxynitride at the same unexpectedly low temperatures." (Laxman, col. 4, lines 60 – 64).

Even if Chern and Laxman were combined, the combination would still not result in the limitations of claim 11. In particular, Chern and Laxman do not include the limitation "wherein the first temperature is less than the second temperature." As the Chern and Laxman references, alone or in combination do not teach all the limitations of claim 11, the combination cannot be interpreted do disclose the limitations of claim 11. Therefore, Applicants respectfully request the withdrawal of the rejection of the claims under 35 U.S.C. § 103(a) over the combination.

Claims 12 – 14, 16, and 17 depend either directly or indirectly from independent claim 11, and thus include the limitation "wherein the first temperature is less than the second temperature." As such, Applicants respectfully submit that claims 12 – 14, 16, and 17 are also not unpatentable by the combination of Chern and Laxman under 35 U.S.C. § 103(a) and request withdrawal of the rejection of the claims.

Claims 15, 18 and 19 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Chern and Laxman and further in view of Miles. Claims 15, 18, and 19 depend either directly or indirectly from independent claim 11, and thus include the limitation, "wherein the first temperature is less than the second temperature."

As discussed above, both Chern and Laxman do not teach or suggest depositing a first silicon oxide film at a first temperature and a silicon nitride film at a second temperature which is greater than the first temperature. Miles discloses an insulating spacer 4 provided on sidewalls of the gates 3. This insulating spacer 4 is typically silicon dioxide or silicon nitride. Typically, this spacer, when present, is about 60 Å to about 500 Å and more typically about 100 Å to about 400 Å thick. The insulating sidewall spacer 5 is provided on the first sidewall spacer 4. The second sidewall spacer is typically silicon nitride. The silicon nitride spacers are generally L-shaped and include spacing between adjacent spacers on adjacent gate structures. (Miles, col. 3, lines 6 – 16, and FIG. 1). Nothing in Miles teaches or suggests depositing a first silicon oxide film at a first temperature and a silicon nitride film at a second temperature which is greater than the first temperature. As such, Miles fails to cure the deficiencies of Chern and Laxman.

It is respectfully submitted that Chern, Laxman, and Miles do not teach or suggest a combination with each other. Applicants respectfully submit that it would be impermissible hindsight, based on Applicants' own disclosure to combine Chern, Laxman, and Miles.

Applicants also respectfully submit that there is no motivation to combine Chern, Laxman, and Miles. The Office Action states, "It would have been obvious for one of ordinary skill in the art, at the time of the invention to form source/drain regions adjacent to the gate of the Chern as taught by Miles to reduce source/drain depth adjacent to the gate." (Office Action dated 05/19/2003, page 6). Here, the Office Action merely states an advantage of substituting the source/drain regions of

Miles into Chern without explaining what specific understanding or technological principle within the knowledge of one of ordinary skill in the art would have suggested the combination.

Even if Chern, Laxman, and Miles were combined, the combination would still not result in the limitations of claim 11. In particular, Chern, Laxman, and Miles do not include the limitation "wherein the first temperature is less than the second temperature." As the Chern, Laxman, and Miles references, alone or in combination do not teach all the limitations of claim 11, the combination cannot be interpreted do disclose the limitations of claim 11. Therefore, Applicants respectfully request the withdrawal of the rejection of claims 15, 18, and 19, which depend from claim 11, under 35 U.S.C. § 103(a) over the combination.

If the allowance of these claims could be facilitated by a telephone conference, the Examiner is invited to contact Suk Lee at (408) 720-8300.

Pursuant to 37 C.F.R. § 1.136(a)(3), applicant(s) hereby request and authorize the U.S. Patent and Trademark Office to (1) treat any concurrent or future reply that requires a petition for extension of time as incorporating a petition for extension of time for the appropriate length of time and (2) charge all required fees, including extension of time fees and fees under 37 C.F.R. 1.16 and 1.17, to Deposit Account No. 02-2666.

Respectfully submitted,
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Dated: February 27, 2004

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